REMARKS

Claims 1-4, 7-19, and 22-26, as amended, remain in the case. New claims 28-51 are presented for examination for the first time.

1. With respect to the rejection under 35 U.S.C. §112, second paragraph, please note that claims 4 and 19 have now been rewritten to refer to an agricultural combine, e.g., a mobile device for harvesting and threshing grain and other agricultural products.

In claim 11, the added words now specifically define the variable "R" as a reference spectrum and the variable "S" as the sample spectrum. This is now consistent with the description of these variables as set forth at page 16 of the specification which describes the calibration procedure.

2. Before addressing the rejections set forth in the last Office Action, we first wish to bring to the attention of the Examiner certain prior art publications and activities by the Applicant himself.

In particular, a near infra-red (NIR) spectro-photometer instrument called the "DPA200 Spectrophotometer", was described in a paper authored by the inventor entitled "A Compact, Solid State Spectrophotometer System for Process Monitoring", Process Control and Quality, Vol. 5 (1993), pp. 1-8 (Mayes' paper).

The DPA200 spectrophotometer was based on the use of charge a coupled device (CCD) array. The particular device described in the publication incorporated a 1024 element CCD detector array

for acquiring spectral information [see Mayes' paper, first paragraph, right hand column, page 3].

A stabilized tungsten/halogen lamp supply provided the light source in the DPA spectrophotometer. The detector in the DPA 200 used a single 600 µm optical fiber for spectral data acquisition. [See Mayes' paper, last paragraph, left hand column, page 3].

The DPA 200 also used a proprietary passive wavelength dispersion device. The wavelength dispersion device referred to in the paper was a type of linear variable filter (LVF) which provided dispersion over the desired infrared wavelengths [see the Declaration of Dr. Mayes enclosed herewith].

Later versions of this spectrophotometer also incorporated a grin lens attached to the output of the optical fiber. The grin lens was used as a mode mixer. A DPA spectrophotometer incorporating a grin lens was sold before December, 1995. [Mayes' Declaration].

The DPA spectrophotometer system therefore included a number of optical components that correspond to certain elements of the presently claimed invention, including:

a tungsten light source;

a fiber optic for picking up electromagnetic radiation;

a mode mixer, which was the grin lens;

a linear variable filter, for spatially separating detected light wavelengths, and

a charged coupled device (CCD) array, for individually detecting in parallel the strengths of the various wavelengths.

However, this prior art DPA 200 spectrophotometer was designed and used only as a laboratory instrument. The DPA spectrophotometer was applied to a number of laboratory analysis

or industrial process applications, including flow injection analysis, clinical analysis, segregation of percent fat in meat products, percent oil and moisture in margarine, octane of gasoline, agricultural products, food processing, petrochemicals, and pharmaceuticals [see the DSquared Development Inc. Product Brochure].

However, the DPA spectrophotometer systems were not adapted for use within mobile agricultural equipment to determine the properties of grain in real time as it is being harvested in the field.

We believe that the claims as amended are patentable over this earlier device. With the prior art DPA systems, grain analysis was still carried out in the laboratory. Several steps were therefore necessary in the handling of grain samples before their constituent properties could be known. The sample had to be harvested, collected, and shipped to the laboratory, not to mention the fact that the results from the laboratory had to then be sent back to the farmer, researcher or other person in the field.

It was only later that the the Applicant realized that there is an advantage to placing the spectrometer in the combine or harvester itself. Packaging and arranging the elements of the spectrophotometer optics such that they can be placed within the mobile agricultural equipment itself allows the automation of the process of grain analysis in real time.

The importance of the need for real time analysis on mobile agricultural equpiment, such as a harvester or combine, cannot be underestimated. Having this information available in the field is not only a matter of convenience. The price that the farmer will be able to obtain for grain and other agricultural products is often greatly influenced by the moisture content and other properties.

In addition, information about the properties of the grain as it is being harvested assists in determining how to treat the field with fertilizers. This allows one to immediately treat the field to optimize the next year's harvest, and without having to wait for laboratory results.

We have therefore, amended claim 1 to positively recite the fact that the claimed apparatus is attached to "mobile agricultural equipment".

Independent claim 15 already set forth the limitation that the optical device was placed "in a harvester ... an anaylzer for determining consituent components of an agricultural product as it is being harvested".

Independent claim 16 now recites the fact that the process is being carried out within mobile agricutural equipment.

New independent claims 29, 30, 41, and 52 also contain similar language and are therefore also allowable over the prior art DPA200 spectrophotometer.

We ask the the Examiner also note that the environment in mobile agricultural equipment is dirty, noisy, dusty, and prone to much vibration caused as the agricultural equipment travels down the field at a high rate of speed. It is not the typical environment that one would expect is preferable for carrying out detailed, accurate analysis of the chemical properties of samples. Not just any type of spectromter will perform properly in this environment. It is the specific optics as claimed in the "CCD" and "linear variable filter (LVF)" limitations of independent claim 30 and certain other claims dependent from claims 1, 16, and 41 which are especially suitable for this task.

If a diffraction grating, prism, or similar dispersion device is used, it must be physically spaced apart from the diode array or other detector. The introduction of this physical

distance introduces a moment arm between the wavelength separation optics and the detector. This moment arm implies an extended structure which is more susceptible to the movement of components with respect to each other due to changes in the environment from vibration, acceleration, temperature, and humidity. Such a moment arm is not introduced in the Applicant's device, which uses a compact linear variable filter in which the light transmissive properties of the dispersive material itself are used to separate the wavelengths.

The use of a CCD detector offers the unique feature of obtaining a full spectrum analysis in one time period. This is unlike other electronic scanning devices such as photo diode arrays or scanning grating devices in which the individual diodes or individual wavelengths must be scanned over time.

In other words, Applicant's adoption of a linear variable filter and CCD detector were motivated by the particular environment encountered. Applicant was faced with avoiding a number of difficulties associated with implementations using optical separation components that are expected to be deployed in mobile argicultural equipment such as combines, harvesters, and the like as they operate. This operational location is far more susceptible to environmentally-induced measurement errors caused by the mechanical vibration, temperature, humidity, dust and electromagnetic interference conditions generated by the harvesting equipment. Each of these environmental variables can induce errors if diffraction gratings and other optical components which rely upon physical separation to detect the different wavelengths.

Therefore, claims 3, 13, 18, 30-40, and 44 should be allowed for these additional reasons.

3. Now returning attention to the rejections set forth in the Office Action, Claims 1-2 and 16-17 stand rejected under 35 U.S.C. §102(b) as being anticipated by Tobler et al.

We believe there are significant distinguishing features of the invention now more positively set forth in claim 1, 16, and 27.

In particular, we agree that the Tobler patent discloses a system for detecting grain properties, as shown in his Fig. 7, which includes a near infrared light source, a sampling channel, an optical pick up, a wavelength separator, and detector.

However, claim 1, as now amended, specifically sets forth the fact that the apparatus is being used to determine the constituent components of a flowing stream of agricultural product with the spectrometer apparatus itself being located within mobile agricultural equipment.

There is no mention or suggestion in the Tobler patent that the process to be carried out on in the field on mobile equipment, e.g., a combine or harvester. Tobler shows the product being processed on a conveyor belt and a production feed pipe assembly in Fig. 6. Thus, while Tobler may be said to disclose the processing of a flowing agricultural product stream, there is no description, illustration, or even a suggestion that the device is used to analyze grain as it is being processed within mobile agricultural equipment.

Similarly, claims 16, 29, 30, 41, and 52 also now sets forth the limitation that the apparatus is processing a flowing stream of agricultural product as it is being harvested, or that the optics are located within mobile equipment.

These features of the claimed invention are not found within the cited reference, and therefore we respectfully request that the rejection of claims 1-2 and 16-17 under 35 U.S.C. §102 be withdrawn.

Please also note that newly added claim 29 corresponds identically to a claim which was in the previously pending application from which the present application claims priority. More specifically, new claim 29 is identical to a claim 3 which was originally presented in the parent application, Serial No. 08/777,228 filed December 30, 1996. In the Office Action issued in that application on October 1, 1997 (A copy enclosed as Appendix 1), a number of rejections of the claims were made in view of the same Tobler reference and other references. However, it was indicated at page 5 of that Office Action that claim 3 was only objected to as being depending upon a rejected base claim.

4. Other claims pending in the application, including claims 3, 13, and 18, were rejected under 35 U.S.C. §103(a) as being unpatentable over Tobler in view of Labaw. The Examiner was of the opinion that Labaw teaches a linear variable filter and CCD detector combination. He then concluded that it would be obvious to substitute the linear variable filter combination taught by Labaw in the grain detector array of Tobler.

The Labaw patent indeed discloses an imaging system having an integrated filter and photodetector array. The device is used in an aerospace application, where it is desired to form two-dimensional infrared images, such as to form images of terrestrial objects in a space reconnaissance mission.

A difficulty with such systems has been to cool the infrared detectors to below extremely cold temperatures in order to reduce their sensitivity to ambient heat. Now, the Labaw patent does show a dispersing element which is used in effect, as a "cooling filter" by coating a material with appropriate filtering characteristics directly onto the CCD array itself. Thus, Labaw is not, strictly speaking, using the filter as a

wavelength separator but rather to lower the background noise, having already obtained dispersion with a separate dispersive element. The filter provides no additional wavelength discrimination. Its sole purpose is to enable the detector to have a reduced flux of background radiation.

We can certainly find no suggestion in Labaw that a linear variable filter and CCD detector can be used in combination to advantage in an application such as for processing grain in mobile agricultural equipment such as in a combine or harvester. Specifically, it is Applicant who has recognized that a linear variable filter and CCD detector combination provide a compact and environmentally stable package to advantage in such an application.

There being no suggestion within Tobler to use the claimed linear variable filter or CCD array, and there being no teaching or suggestion in Labaw to adapt his two-dimensional satellite imaging system adpated optics to solve the problems associated with anaylsis of grain propoerties in the field, we believe the claims are not obvious and meet the tests of patentability.

Newly added claims 30-40 also contain the linear variable filter and CCD array limitations and should be allowed for the same reasons.

5. Claims 7-12 and 22-26 were also rejected as being unpatentable over Tobler et al. in view of Zarling et al. and Shields. The Examiner was of the opinion that Zarling shows an apparatus comprising a "mode mixer" which the Examiner pointed out as being shown in Fig. 2b, item 45.

Upon our examination of the Zarling reference, however, we note that item 45 is not a mode mixer but rather a radio frequency mixer. The radio frequency mixer shown in Zarling is

an electrical device that has a different purpose than the mode mixer in Applicant's claimed invention.

The mode mixer described in the invention is an optical device that is intended to suppress higher order optical modes which are introduced by vibrations in the optic fiber. In the present invention, the optical pick up is physically separated at some distance from the analysis electronics by an optical fiber. For example, the pick up may be inserted next to grain chute; however, the analysis electronics may be placed back in the cab portion of an agricultural harvesting machine. The particular length of optic fiber may therefore be susceptible to vibration as the harvesting machine travels through a grain field.

It therefore appears to us that the Examiner has simply found a prior art reference with a "mixer" of some type and then has ascribed the same functions and purpose as that of the claimed invention. This is an impermissible combination of selection of elements from various places in the prior art and combining them as the inventor has suggested.

There is no suggestion in Zarling that a mixer of any kind, and certainly not the optical mode mixer as claimed, be combined and connected to the output of an optical pick up in order to remove optical modes induced in a fiber such as through vibration in agricultural harvesting equipment.

Newly added claims 41-51 contain the optical fiber and mode mixer limitations, and therefore should be allowed for the same reasons set forth for claims 7-12.

Also note that new claim 52 is identical to the previously allowed claim 29 adding an additional feature of the mode mixer. It therefore should also be allowed for the same reasons as claim 29.

6. We furthermore note that the claimed method of calibration making use of referenced spectrum currents R and sample spectrum S as set forth in claim 11, and the specific method of calibrating constituent components by measuring a dark spectrum D and the reference spectrum by using optics block shutters and a pick up shutter as set forth in claim 25, are also not disclosed or discussed in the cited references.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned at (781) 861-6240.

Respectfully submitted,
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